

## Chapter 16 - Galileo Discovers the Moons of Jupiter

### Galileo Galilei (1610)

#### Introduction

Galileo Galilei, (1564-1642) the gifted and extremely curious Italian scientist, made great use of the telescope to discover such unsettling things as the irregularities of the moon's surface; it was believed at the time to be perfectly smooth, a belief which conformed to Catholic dogma. Moreover, Galileo's observations with the telescope led him to the conclusion that Nicolas Copernicus (1473-1543) was right: the earth did indeed orbit around the sun and not vice versa. Such a viewpoint cast great doubt on the accepted natural philosophy (first enunciated by Aristotle) of a geocentric universe and thus of human beings' centrality in the universe. Thus the conflict between religion and science in the seventeenth century was begun. In this excerpt Galileo describes his discovery of the moons of Jupiter from January to March, 1610. This discovery also cast doubt on the perfection of the Aristotelian universe which had been described by the Egyptian astronomer Ptolemy in the second century, A.D.

#### Questions to Consider

- One of the hallmarks of the Scientific Revolution was the establishment of the scientific method of inquiry. How does Galileo's notebook description of his observations help to establish the scientific method?
- How does Galileo's discovery challenge existing scientific and religious beliefs?

---

On the seventh day of January in this present year 1610, at the first hour of night, when I was viewing the heavenly bodies with a telescope, Jupiter presented itself to me; and because I had prepared a very excellent instrument for myself, I perceived (as I had not before, on account of the weakness of my previous instrument) that beside the planet there were three starlets, small indeed, but very bright. Though I believed them to be among the host of fixed stars, they aroused my curiosity somewhat by appearing to lie in an exact straight line parallel to the ecliptic, and by their being more splendid than others of their size. Their arrangement with respect to Jupiter and each other was the following:

East \* \* O \* West

that is, there were two stars on the eastern side and one to the west...on January eighth - led by what, I do not know - I found a very different arrangement. The three starlets were now all to the west of Jupiter, closer together, and at equal intervals from one another as shown in the following sketch:

East O \* \* \* West

At this time, though I did not yet turn my attention to the way the stars had come together, I began to concern myself with the question how Jupiter could be east of all these stars when on the previous day it had been west of two of them....

On the tenth of January, however, the stars appeared in this position with respect to Jupiter:

East \* \* O West

that is, there were but two of them, both easterly, the third (as I supposed) being hidden behind Jupiter. As at first, they were in the same straight line with Jupiter and were arranged precisely in the line of the zodiac. Noticing this, and knowing that there was no way in which such alterations could be attributed to

1 Jupiter's motion, yet being certain that these were still the same stars I had observed (in fact no other was  
2 to be found along the line of the zodiac for a long way on either side of Jupiter), my perplexity was now  
3 transformed into amazement. I was sure that the apparent changes belonged not to Jupiter but to the  
4 observed stars, and I resolved to pursue this investigation with greater care and attention.

5  
6 And thus, on the eleventh of January, I saw the following disposition:

7  
8 East \* \* O West  
9

10 ...I had now decided beyond all question that there existed in the heavens three stars wandering about  
11 Jupiter as do Venus and Mercury about the sun, and this became plainer than daylight from observations  
12 on similar occasions which followed. Nor were there just three such stars; four wanderers complete their  
13 revolutions about Jupiter, and of their alterations as observed more precisely later on we shall give a  
14 description here. Also I measured the distances between them by means of the telescope, using the  
15 method explained before. Moreover I recorded the times of the observations, especially when more than  
16 one was made during the same night - for the revolutions of these planets are so speedily completed that it  
17 is usually possible to take even their hourly variations. [Galileo continues to make similar observations  
18 until March 2, noting the changes in the "stars" adjacent to Jupiter.]...

19  
20 Such are the observations concerning the four Medicean planets recently first discovered by me, and  
21 although from this data their periods have not yet been reconstructed in numerical form, it is legitimate at  
22 least to put in evidence some facts worthy of note. Above all, since they sometimes follow and sometimes  
23 precede Jupiter by the same intervals, and they remain within very limited distances either to east or west  
24 of Jupiter, accompanying that planet in both its retrograde and direct movements in a constant manner, no  
25 one can doubt that they complete their revolutions about Jupiter and at the same time effect all together a  
26 twelve-year period about the center of the universe. That they also revolve in unequal circles is manifestly  
27 deduced from the fact that at the greatest elongation from Jupiter it is never possible to see two of these  
28 planets in conjunction, whereas in the vicinity of Jupiter they are found united two, three, and sometimes  
29 all four together. It is also observed that the revolutions are swifter in those planets which describe  
30 smaller circles about Jupiter, since the stars closest to Jupiter are usually seen to the east when on the  
31 previous day they appeared to the west, and vice versa, while the planet which traces the largest orbit  
32 appears upon accurate observation of its returns to have a semimonthly period.

33  
34 Here we have a fine and elegant argument for quieting the doubts of those who, while accepting with  
35 tranquil mind the revolutions of the planets about the sun in the Copernican system, are mightily  
36 disturbed to have the moon alone revolve about the earth and accompany it in an annual rotation about the  
37 sun. Some have believed that this structure of the universe should be rejected as impossible. But now we  
38 have not just one planet rotating about another while both run through a great orbit around the sun; our  
39 own eyes show us four stars which wander around Jupiter as does the moon around the earth, while all  
40 together trace out a grand revolution about the sun in the space of twelve years....